Permeable Reactive Barriers for Ground-Water Restoration

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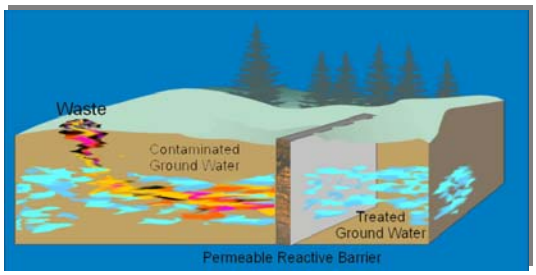
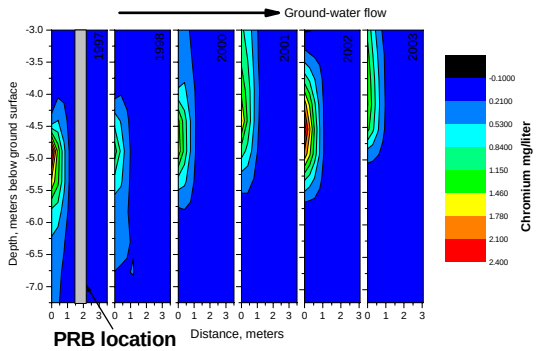
Background: A Permeable Reactive Barrier (PRB) is a zone of granular reactive material that extends below the water table to intercept the flow of contaminated ground water. As organic or inorganic contaminants pass through a PRB, they are reduced to non-hazardous compounds or they are immobilized to less soluble or less toxic forms. The PRB technology can accelerate site cleanup and closure at Superfund and other hazardous waste sites; the federal government and states spend nearly $4 billion annually to clean up these sites.

Scientific Approach: Over the past 10 years, research projects conducted by research staff at EPA's Office of Research and Development have focused on field and laboratory evaluations of geochemical, hydrogeological, and microbiological factors that govern the performance and functioning of PRBs. Understanding these factors is necessary in order to predict the longevity of PRB systems, conduct economic analyses, and to optimize implementation of this ground-water cleanup technology for a wide variety of hazardous compounds. Research has been carried out to provide EPA Regional Offices and Program Offices with data collection tools and technical proficiency for assessing PRB applications, and to provide regulators and the regulated community with a scientific and economic framework for selecting ground-water cleanup technologies that is based upon site-specific variables.

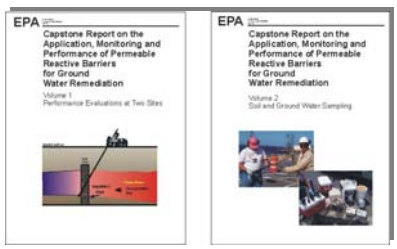
Accomplishments: More than 100 sites world-wide have implemented this technology to treat chlorinated solvent compounds, fuel hydrocarbons, and various inorganic contaminants in ground water. EPA's long-term performance observations at two PRB sites now approach 8 years (see EPA/600/R-03/045). It is clear that effective lifetimes exceeding 10 years are reasonable to expect and PRBs may function sufficiently for up to 30 years. Adequate site characterization is necessary on the scale of the PRB. Understanding site hydrology has emerged as perhaps the most important factor for successful, long-term implementation.



Schematic Diagram of a Permeable Reactive Barrier



Cross-sectional profile of dissolved chromium concentrations at a PRB site from 1997 to 2003. Over this time period the PRB has effectively removed chromium from ground water and a clean front has appeared on the downgradient side of the PRB ($\Sigma Cr < 5$ µg/liter).



Capstone Report on the Application, Monitoring, and Performance of Permeable Reactive Barriers for Ground-Water Remediation (EPA/600/R-03/045 a,b).

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